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(54) **RACK AND PINION STEERING GEAR WITH LOW FRICTION ROLLER YOKE DESIGN**

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(52) **U.S. Cl.** .... **74/388 PS**; 74/409
(58) **Field of Search** .... 74/422, 409, 388 PS, 74/384; 384/53, 54

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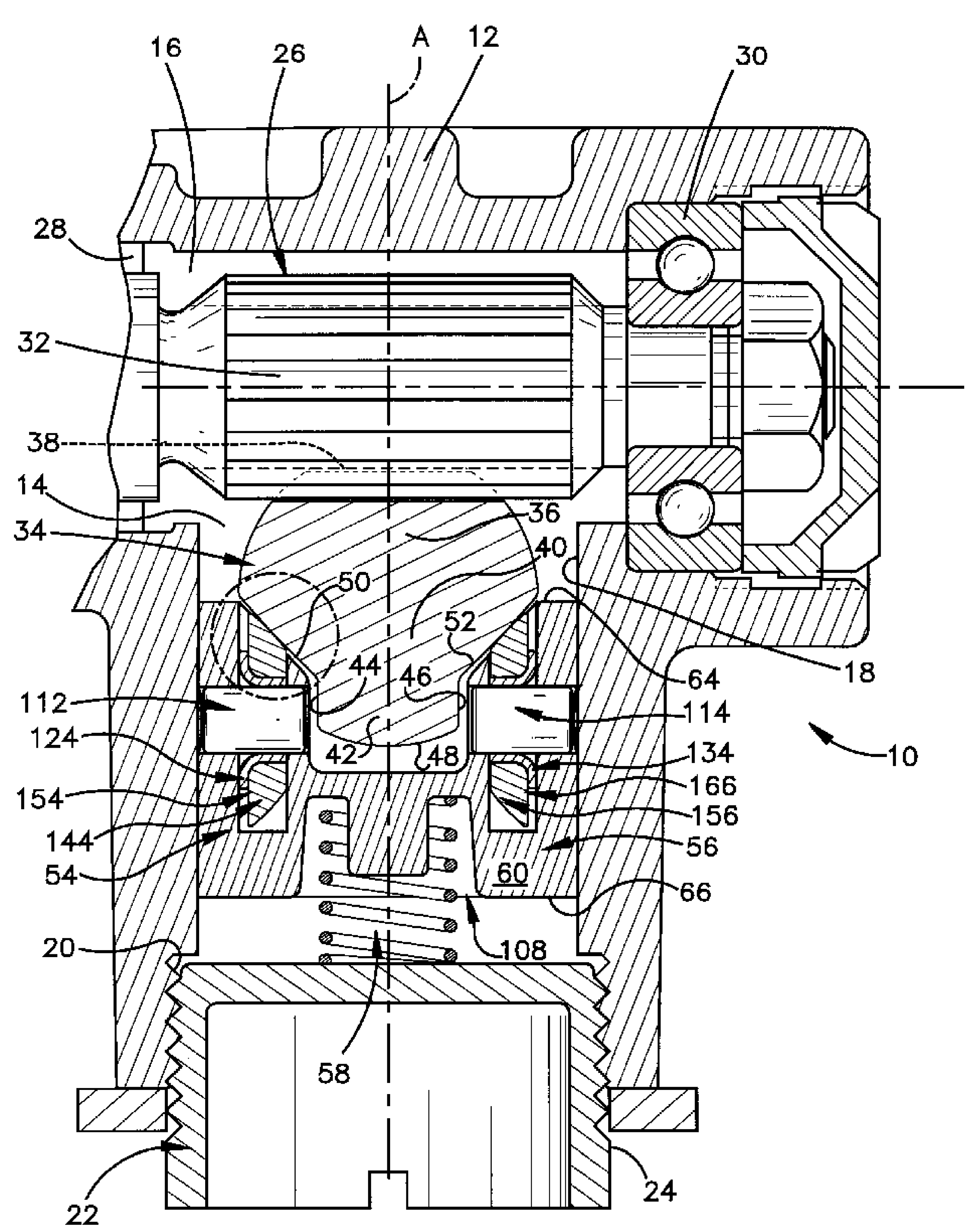
(57) **ABSTRACT**

A rack and pinion steering gear (**10**) comprises a housing (**12**) having an axially extending passage (**14**) and a yoke bore (**18**) that intersects the axially extending passage (**14**) within the housing (**12**). A pinion gear (**26**) is rotatably mounted in the housing (**12**). A rack bar (**34**) extends through the axially extending passage (**14**) and is movable relative to the pinion gear (**26**). The rack bar (**34**) has teeth in meshing engagement with teeth (**32**) of the pinion gear (**26**). A yoke assembly (**54**) is located in the yoke bore (**18**) of the housing (**12**) for at least partially supporting and guiding movement of the rack bar (**34**) relative to the pinion gear (**26**). The yoke assembly (**54**) comprises a yoke (**56**) having first and second roller assemblies (**154** and **166**) for contacting the rack bar (**34**) and rotating during movement of the rack bar (**34**). A first spindle (**112**) supports the first roller assembly (**154**) and a second spindle (**114**) supports the second roller assembly (**166**).

14 Claims, 4 Drawing Sheets



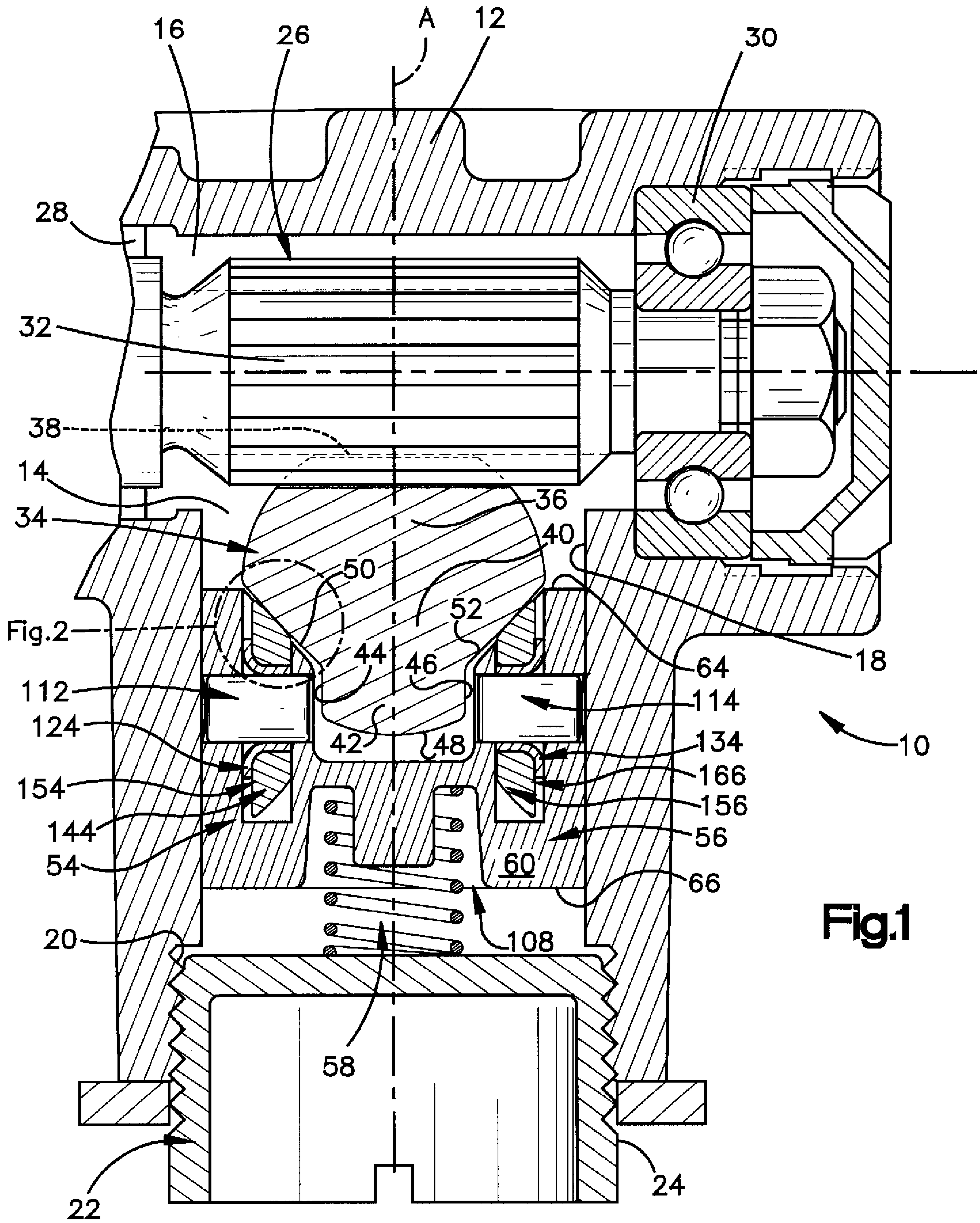


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Fig.2
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Fig.1

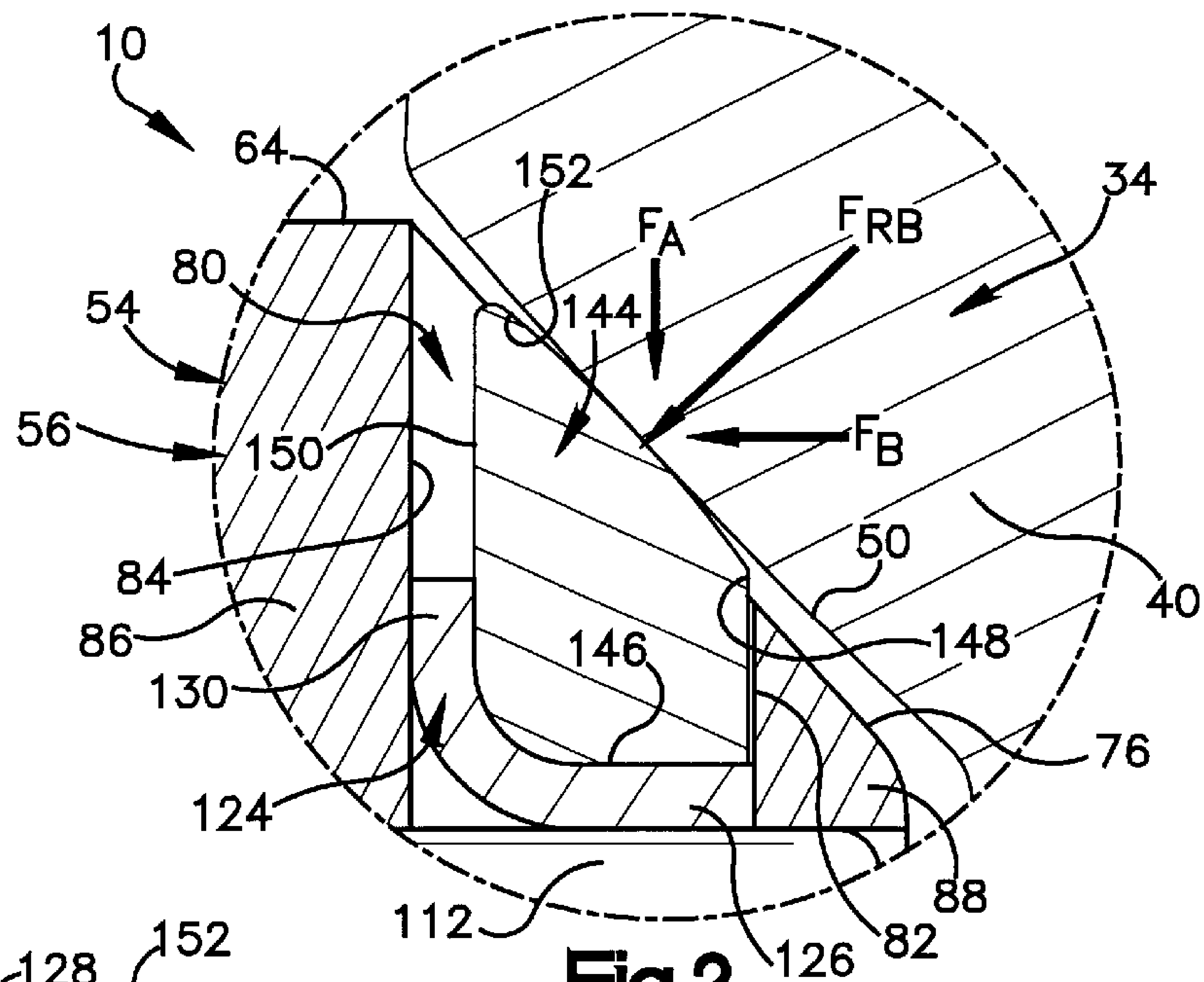
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Fig.2

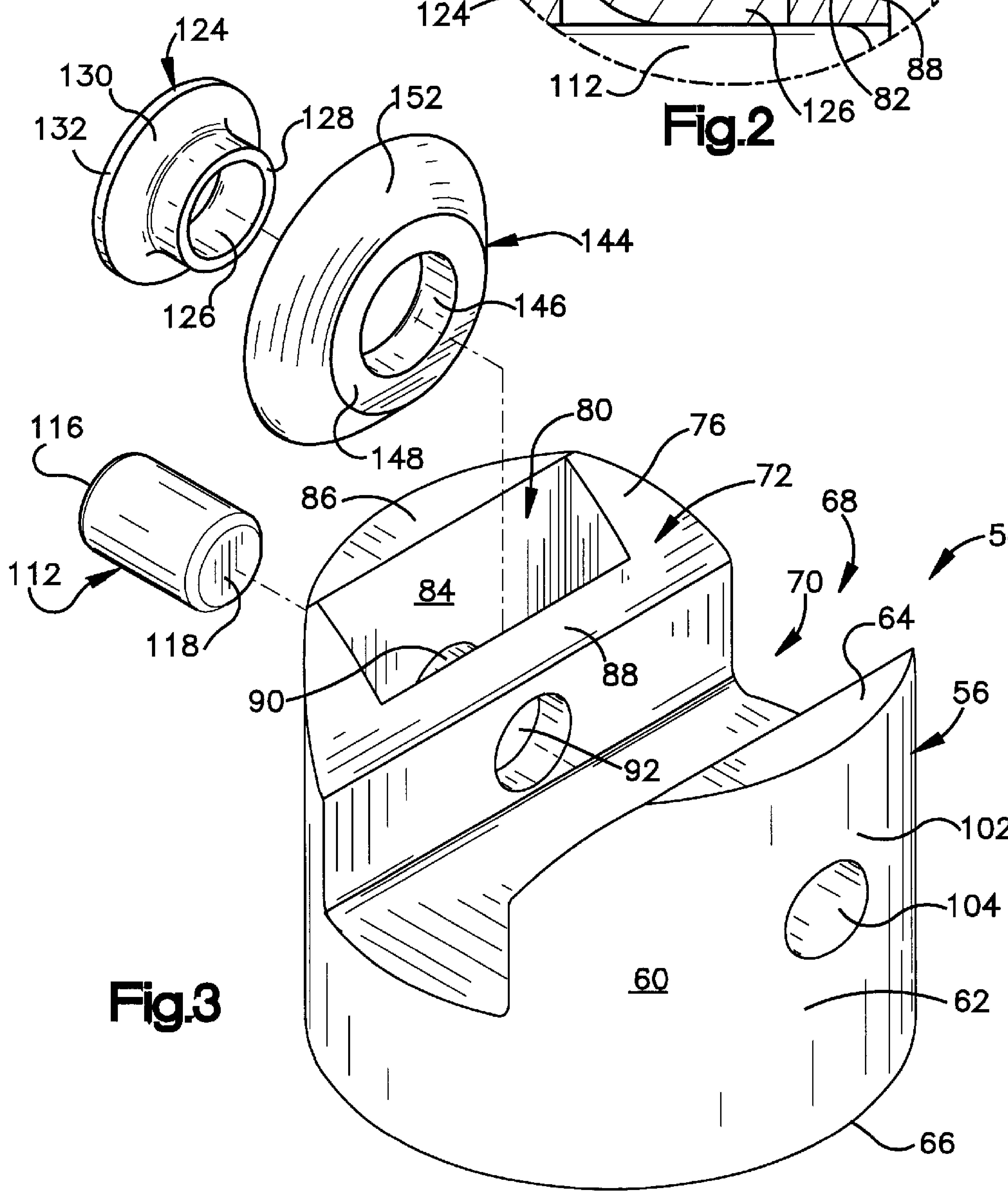
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Fig.3

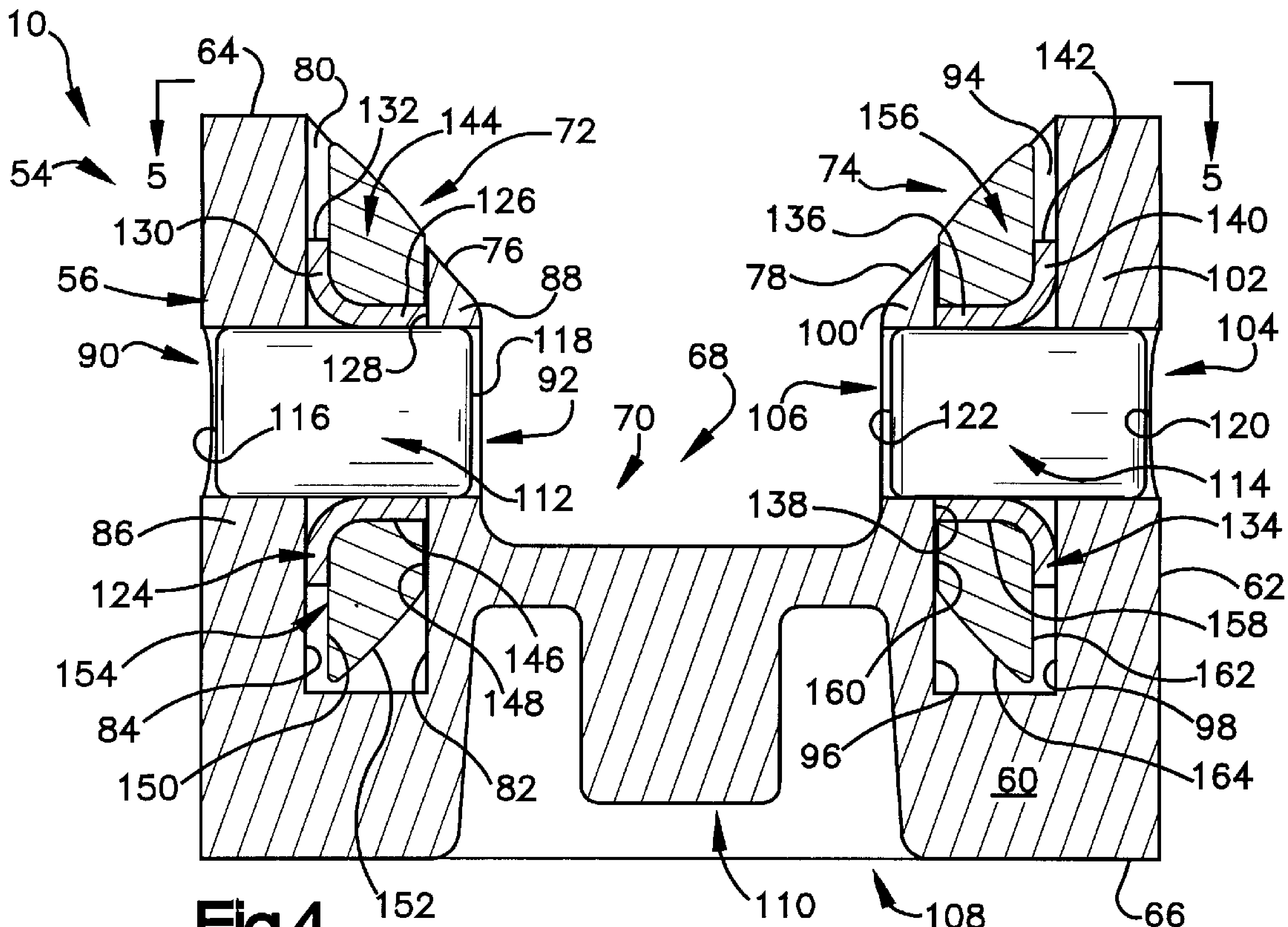
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Fig.4

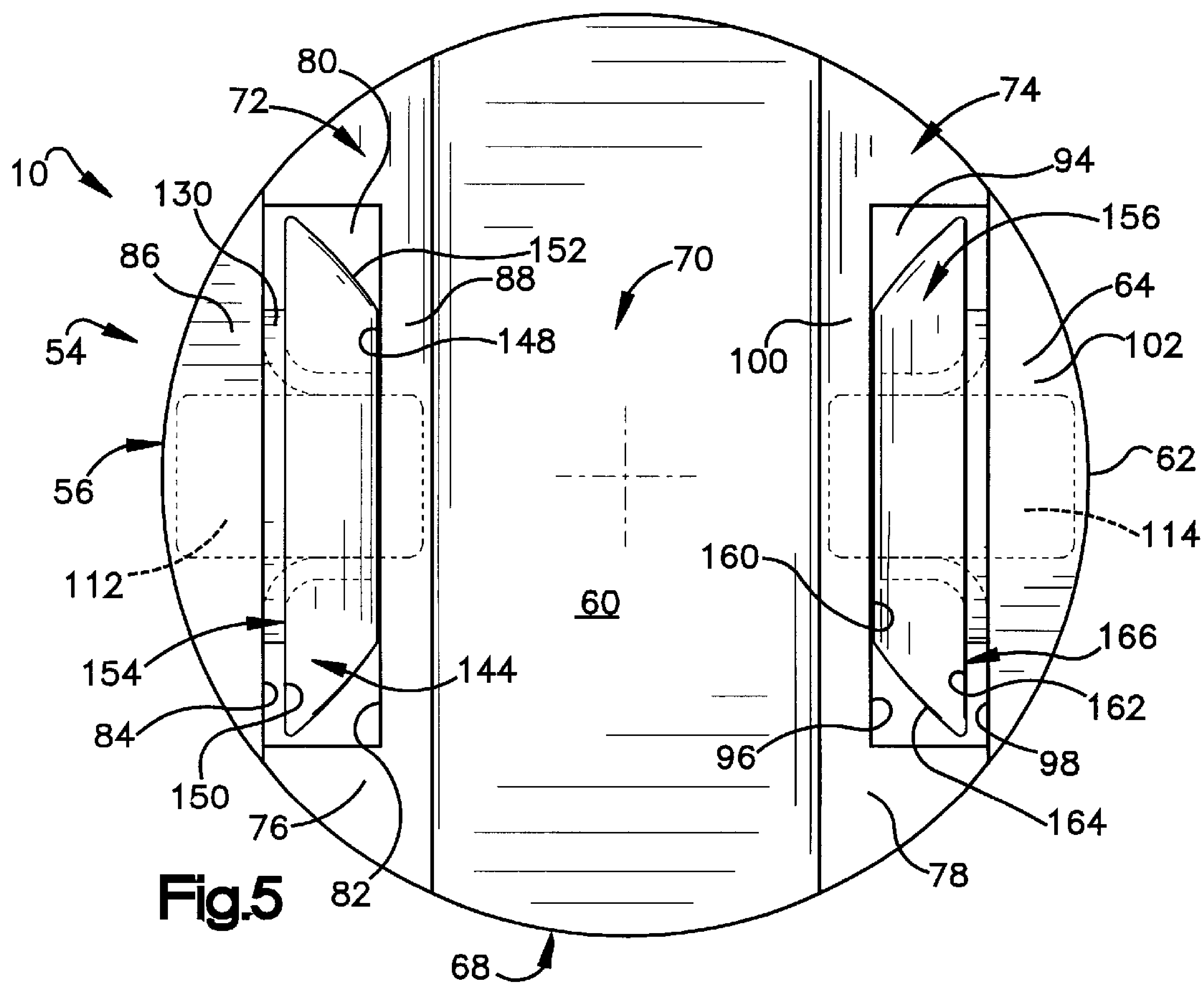
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Fig.5

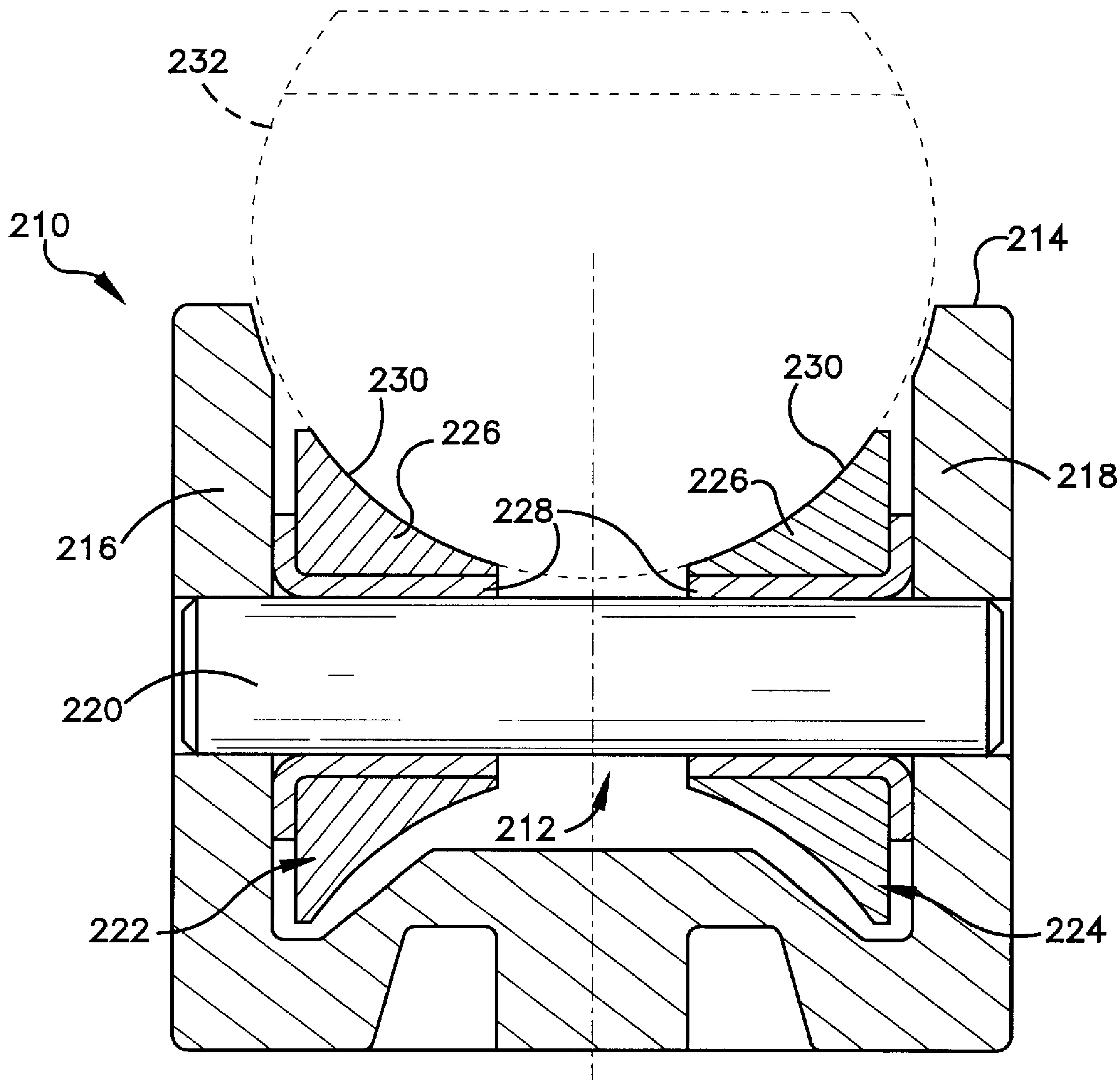

Fig.6
(PRIOR ART)

RACK AND PINION STEERING GEAR WITH LOW FRICTION ROLLER YOKE DESIGN

TECHNICAL FIELD

The present invention relates to a rack and pinion steering gear and, more particularly, to a rack and pinion steering gear having a low friction yoke assembly.

BACKGROUND OF THE INVENTION

A known rack and pinion steering gear includes a pinion gear that is rotatably mounted in a housing and is connected with a steering wheel of a vehicle. A rack bar extends axially through the housing and has opposite end portions connected with steerable vehicle wheels. Gear teeth formed on the rack bar are disposed in meshing engagement with gear teeth on the pinion gear. A yoke assembly, including a yoke and a spring, is disposed in the housing to support and guide movement of the rack bar relative to the housing.

The yoke **210** of the known rack and pinion steering gear is shown in FIG. **6**. An axially extending cavity **212** extends through the yoke **210** and intersects an upper surface **214** of the yoke **210**. The axially extending cavity **212** forms diametrically opposite first and second support walls **216** and **218**. The first and second support walls **216** and **218** support a spindle **220** that extends across the axially extending cavity **212** of the yoke **210**. The length of the spindle **220** is approximately equal to the diameter of the yoke **210**. The spindle **220** supports first and second roller assemblies **222** and **224** within the axially extending cavity **212**. The first roller assembly **222** is near the first support wall **216** and the second roller assembly **224** is near the second support wall **218**. Each of the first and second roller assemblies **222** and **224** include a roller **226** that is fixed to a bushing **228**. Each roller **226** has a concave bearing surface **230** for contacting and supporting the rack bar **232**. The first and second roller assemblies **222** and **224** rotate relative to the yoke **210** and the spindle **220** during axial movement of the rack bar **232**.

During operation of this known rack and pinion steering gear, the yoke assembly may be subjected to both heat and high loads. The heat is produced by friction, generally between the rack bar **232** and the bearing surfaces **230** of the rollers **226** as the rack bar **232** moves over the rollers **226**. A high load may occur, for example, when a vehicle hits a pothole in the road surface. The impact load of the vehicle tire with the pothole is transferred to the rack bar **232** through the vehicle tie rods. The rack bar **232**, in turn, transfers a portion of the load to the yoke assembly. The load transferred to the yoke assembly should be absorbed by the spring that biases the yoke **210** against the rack bar **232**. However, in the yoke assembly of the known rack and pinion steering gear, the load of the rack bar **232** on the rollers **226** creates a significant bending moment on the spindle **220**. As a result, the load may cause the spindle **220** to bend in a location between the roller assemblies **222** and **224**. When the spindle **220** bends, rotation of the first and second roller assemblies **222** and **224** may be impaired and increased friction and heat may develop between the rack bar **232** and the yoke assembly.

SUMMARY OF THE INVENTION

The present invention is a rack and pinion steering gear. The rack and pinion steering gear comprises a housing having an axially extending passage and a yoke bore that extends perpendicular to the axially extending passage and

connects with the axially extending passage within the housing. A pinion gear having teeth is rotatably mounted in the housing. A rack bar extends through the axially extending passage of the housing and is movable relative to the pinion gear. The rack bar has teeth in meshing engagement with the teeth of the pinion gear. A yoke assembly is located in the yoke bore of the housing for at least partially supporting and guiding axial movement of the rack bar relative to the pinion gear. The yoke assembly comprises a yoke having first and second roller assemblies for contacting the rack bar and rotating during axial movement of the rack bar. A first spindle is fixed to the yoke and supports the first roller assembly and a second spindle is fixed to the yoke and supports the second roller assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other features of the present invention will become apparent to those skilled in the art to which the present invention relates upon reading the following description with reference to the accompanying drawings, in which:

FIG. **1** is a cross-sectional view of a rack and pinion steering gear having a yoke assembly constructed in accordance with the present invention;

FIG. **2** is an enlarged view of a portion of the rack and pinion steering gear of FIG. **1**;

FIG. **3** is an exploded view of a first roller assembly of a yoke of the yoke assembly shown in FIG. **1**;

FIG. **4** is a cross-sectional view of the yoke assembly of FIG. **1**;

FIG. **5** is a view taken along line **5**—**5** in FIG. **4**; and

FIG. **6** illustrates a prior art yoke.

DETAILED DESCRIPTION OF THE INVENTION

A cross-sectional view of a rack and pinion steering gear **10** constructed in accordance with the present invention is illustrated in FIG. **1**. The rack and pinion steering gear **10** includes a housing **12**. Preferably, the housing **12** is made of cast metal. The housing **12** includes an axially extending passage **14**, extending perpendicular to the plane of FIG. **1**. A pinion passage **16** extends into the housing **12** and tangentially intersects the axially extending passage **14**. A yoke bore **18** also extends into the housing **12** and connects with the axially extending passage **14**. The yoke bore **18** extends in a direction perpendicular to the axially extending passage **14**. In FIG. **1**, axis A represents a central axis of the yoke bore **18**. Axis A extends in a direction perpendicular to the axis of the axially extending passage **14**. As shown in FIG. **1**, the yoke bore **18** is located on a side of the axially extending passage **14** opposite the pinion passage **16**. The yoke bore **18** terminates at a threaded opening **20**. A cylindrical plug **22** having a threaded outer surface **24** screws into the threaded opening **20** of the yoke bore **18** to close the end of the yoke bore **18**.

A pinion gear **26** is located in the pinion passage **16** of the housing **12**. Two bearing assemblies **28** and **30** rotatably support the pinion gear **26** in the housing **12**. The first bearing assembly **28** is located at one end of the pinion gear **26**. A second bearing **30** assembly is located at an opposite end of the pinion gear **26**. A plurality of teeth **32** extends around the outer circumference of the pinion gear **26**. The pinion gear **26** is connected with the vehicle steering wheel (not shown) in a known manner.

A portion of an axially extending rack bar **34** extends through the axially extending passage **14** of the housing **12**.

The rack bar **34** has opposite end portions (not shown) that are connected to steerable wheels (not shown) of a vehicle through tie rods (not shown). The rack bar **34** illustrated is commonly referred to a mini-Y rack bar. Although the mini-Y rack bar is preferred, those skilled in the art will recognize that any known type of rack bar may be used with the invention.

When viewed in cross-section, the rack bar **34** has a generally semi-circular upper portion **36**. A flattened upper surface **38** of the upper portion **36** of the rack bar **34** includes a plurality of teeth (not shown). Teeth of the rack bar **34** are disposed in meshing engagement with teeth **32** of the pinion gear **26**.

A lower portion **40** of the rack bar **34** includes an axially extending lobe **42**. A cross-section of the lobe **42** includes parallel first and second side surfaces **44** and **46**, respectively, and an arcuate bottom surface **48**. The arcuate bottom surface **48** is located opposite the teeth of the upper portion **36** of the rack bar **34**. The first and second side surfaces **44** and **46** extend in a direction parallel to axis A and connect the arcuate bottom surface **48** of the lobe **42** to first and second contact surfaces **50** and **52**, respectively. The lobe **42** has a width, defined as the distance between the first and second side surfaces **44** and **46**, of approximately forty-five percent of the diameter of the semi-circular upper portion **36**. The lobe **42** has a depth, defined as the distance along axis A between the first contact surface **50** and the arcuate bottom surface **48** of the lobe **42**, of approximately one-half the width of the lobe **42**. The first and second contact surfaces **50** and **52** of the lower portion **40** of the rack bar **34** are flat. The first contact surface **50** connects the first side surface **44** of the lobe **42** to the upper portion **36** of the rack bar **34**. The second contact surface **52** connects the second side surface **46** of the lobe **42** to the upper portion **36** of the rack bar **34**. Both the first and second contact surfaces **50** and **52** extend at an angle of approximately forty-five degrees to axis A.

A low friction yoke assembly **54** is located within the yoke bore **18** of the housing **12**. The yoke assembly **54** at least partially supports and guides movement of the rack bar **34** relative to the housing **12**.

The yoke assembly **54** comprises a yoke **56** and a spring **58**. The yoke **56** is preferably made from steel. The yoke **56** has a cylindrical main body portion **60**. The main body portion **60** includes a cylindrical side wall **62** (FIGS. **3** and **4**) and opposite first and second end surfaces **64** and **66**, respectively. A length of the yoke **56** is defined as the distance along axis A between the first end surface **64** and the second end surface **66**.

The first end surface **64** is nearest the rack bar **34** in the assembled rack and pinion steering gear **10**, as shown in FIG. **1**. A central channel **68** (FIGS. **3**, **4**, and **5**) extends axially, parallel to the rack bar **34**, through the main body portion **60** of the yoke **56** and intersects the first end surface **64**. The central channel **68** includes a central portion **70** and first and second outer portions **72** and **74** (FIG. **4**), respectively. The central portion **70** of the central channel **68** has a width, perpendicular to axis A, that is approximately forty percent of a diameter of the main body portion **60** of the yoke **56** and a depth, along axis A, that is approximately sixty percent of the length of the yoke **56**. The first and second outer portions **72** and **74** of the central channel **68** extend from the first end surface **64** toward the central portion **70** of the central channel **68** at an angle of approximately forty-five degrees, as shown in FIG. **4**. The first outer portion **72** of the central channel **68** defines a first cantered surface **76** (FIG. **5**) of the yoke **56** and the second outer portion **74** of the central channel **68** defines a second cantered surface **78** (FIG. **5**) of the yoke **56**.

A first blind pocket **80** extends into the first cantered surface **76** of the yoke **56**. As shown in FIG. **4**, the first blind pocket **80** has a depth of approximately seventy-five percent of the length of the yoke **56**. As shown in FIG. **5**, the first blind pocket **80** has a length in an axial direction of approximately fifty percent of the diameter of the main body portion **60** of the yoke **56**. A width of the first blind pocket **80** is defined as the distance between an inner side wall **82** and an outer side wall **84** of the first blind pocket **80**. The first blind pocket **80** has a width of approximately twenty-five percent of its length. Both the inner side wall **82** and the outer side wall **84** of the first blind pocket **80** are coated with a wear resistant and low friction coating.

The first blind pocket **80** forms a first support wall **86** and a second support wall **88** in the main body portion **60** of the yoke **56**. The first support wall **86** is defined between the cylindrical side wall **62** of the main body portion **60** of the yoke **56** and the outer side wall **84** of the first blind pocket **80**. A hole **90** (FIGS. **3** and **4**) extends through the first support wall **86** and intersects the first blind pocket **80** in a central location.

The second support wall **88** is defined between the inner side wall **82** of the first blind pocket **80** and the central portion **70** of the central channel **68**. A hole **92** (FIGS. **3** and **4**) extends through the second support wall **88** and intersects the first blind pocket **80**. The hole **92** in the second support wall **88** is coaxial with the hole **90** in the first support wall **86**.

A second blind pocket **94** (FIGS. **4** and **5**) extends into the second cantered surface **78** of the yoke **56**. The second blind pocket **94** has dimensions that are equal to the dimensions of the first blind pocket **80**. As shown in FIGS. **4** and **5**, the second blind pocket **94** has an inner side wall **96** and an outer side wall **98**. Both the inner side wall **96** and the outer side wall **98** of the second blind pocket **94** are coated with a wear resistant and low friction coating.

The second blind pocket **94** forms a third support wall **100** and a fourth support wall **102**. The third support **100** wall is defined between the cylindrical side wall **62** of the main body portion **60** of the yoke **56** and the outer side wall **98** of the second blind pocket **94**. A hole **104** (FIGS. **3** and **4**) extends through the third support wall **100** and intersects the second blind pocket **94** in a central location.

The fourth support wall **102** is defined between the inner side wall **96** of the second blind pocket **94** and the central portion **70** of the central channel **68**. A hole **106** extends through the fourth support wall **102** and intersects the second blind pocket **94**. The hole **106** (FIG. **4**) in the fourth support wall **102** is coaxial with the hole **104** in the third support wall **100**.

As shown in FIG. **4**, the second end surface **66** of the yoke **56** includes a centrally located, annular bore **108**. The bore **108** has an outer diameter of approximately forty percent of the diameter of the main body portion **60** of the yoke **56** and an inner diameter of approximately twenty percent the diameter of the main body portion **60** of the yoke **56**. The bore **108** defines a cylindrical protrusion **110** that extends along axis A toward the second end surface **66** of the yoke **56**.

The yoke **56** further includes first and second spindles **112** and **114** (FIG. **4**), respectively. The first and second spindles **112** and **114** are cylindrical and are preferably made from steel. Each of the first and second spindles **112** and **114** has a length between a first end and a second end of approximately twenty-five percent of the diameter of the main body portion **60** of the yoke **56**. A first end **116** (FIG. **4**) of the first spindle **112** is inserted into the hole **90** in the first support wall **86** and a second end **118** (FIG. **4**) of the first spindle **112** is inserted into the hole **92** in the second support wall **88**. Thus, the first spindle **112** spans the first blind pocket **80**.

A first end **120** (FIG. **4**) of the second spindle **114** is inserted into the hole **104** in the third support wall **100** and a second end **122** (FIG. **4**) of the second spindle **114** is inserted into the hole **106** in the fourth support wall **102**. Thus, the second spindle **114** spans the second blind pocket **94**. Both the first and second spindles **112** and **114** are fixed relative to the yoke **56**.

The first spindle **112** rotatably supports a first bushing **124** (FIGS. **2**, **3**, and **4**). The first bushing **124** is annular and has an inner diameter that is defined by a first portion **126** (FIGS. **2** and **3**) of the first bushing **124**. The first portion **126** of the first bushing **124** extends parallel to the first spindle **112**. The first portion **126** terminates in a first terminal end **128** (FIG. **3**). The first bushing **124** also includes a second portion **130** that curves outwardly of the first portion **126** to define an outer diameter of the first bushing **124**. The second portion **130** of the first bushing **124** terminates at a second terminal end **132** (FIG. **3**).

The second spindle **114** rotatably supports a second bushing **134** (FIG. **4**). The second bushing **134** is annular and has an inner diameter that is defined by a first portion **136** of the second bushing **134**. The first portion **136** of the second bushing **134** extends parallel to the second spindle **114**. The first portion **136** terminates in a first terminal end **138**. The second bushing **134** also includes a second portion **140** that curves outwardly of the first portion **136** to define an outer diameter of the second bushing **134**. The second portion **140** of the second bushing **134** terminates at a second terminal end **142**.

A first roller **144** (FIGS. **3** and **4**) is fixedly attached to the first bushing **124**. The first roller **144** is annular and includes a central surface **146**, an inner surface **148**, outer surface **150** (FIGS. **4** and **5**), and a bearing surface **152**. The central surface **146** defines an inner diameter of the first roller **144**. The central surface **146** receives and is fixed to the first portion **126** of the first bushing **124**. The inner surface **148** is located nearest the central channel **68** of the yoke **56** and the outer surface **150** is opposite the inner surface **148**. The second portion **130** of the first bushing **124** contacts a portion of the outer surface **150** of the first roller **144**. The bearing surface **152** of the first roller **144** extends between the inner surface **148** and the outer surface **150**. The bearing surface **152** is slightly convex so that when contacting a flat surface, point contact is made. The bearing surface **152** forms the outer diameter of the first roller **144** and is angled at approximately forty-five degrees to axis A. The outer diameter of the first roller **144** is approximately ninety percent the length of the first blind pocket **80**. The first roller **144** and the first bushing **124** collectively form the first roller assembly **154**.

A second roller **156** (FIG. **4**) is fixedly attached to the second bushing **134**. The second roller **156** is annular and includes a central surface **158**, an inner surface **160**, outer surface **162**, and a bearing surface **164**. The central surface **158** defines an inner diameter of the second roller **156**. The central surface **158** receives and is fixed to the first portion **136** of the second bushing **134**. The inner surface **160** is located nearest the central channel **68** of the yoke **56** and the outer surface **162** is opposite the inner surface **160**. The second portion **140** of the second bushing **134** contacts a portion of the outer surface **162** of the second roller **156**. The bearing surface **164** of the second roller **156** extends between the inner surface **160** and the outer surface **162**. The bearing surface **164** is slightly convex so that when contacting a flat surface, point contact is made. The bearing surface **164** forms the outer diameter of the second roller **156** and is angled at approximately forty-five degrees to axis A. The outer diameter of the second roller **156** is approximately ninety percent the length of the second blind pocket **94**. The second roller **156** and the second bushing **134** collectively form the second roller assembly **166**.

The yoke assembly **54** further includes a spring **58** (FIG. **1**). The spring **58** is preferably a helical spring with a diameter sized to fit into the annular bore **108** extending into the second end surface **66** of the yoke **56**. In the assembled rack and pinion steering gear **10**, the cylindrical protrusion **110** preferably extends through the center of a portion of the spring **58** for controlling the location of the spring **58** relative to the yoke **56**. The spring **58** is disposed between the yoke **56** and the plug **22**. The spring **58** biases the yoke **56** against the rack bar **34**. As loads on the rack bar **34** vary, the spring **58** will compress or expand so that the yoke **56** may move relative to the plug **22**.

In the assembled rack and pinion steering gear **10**, the bearing surface **152** of the first roller **144** contacts the first contact surface **50** on the lower portion **40** of the rack bar **34** and the bearing surface **164** of the second roller **156** contacts the second contact surface **52** on the lower portion **40** of the rack bar **34**. Since the bearing surfaces **152** and **164** of both the first and second rollers **144** and **156** are slightly convex, only point contact is made between each bearing surface **152** and **164** and the respective contact surface **50** and **52** of the rack bar **34**. Point contact reduces friction and friction related heat between the rack bar **34** the rollers **144** and **156**.

When the first and second rollers **144** and **156** contact the first and second contact surfaces **50** and **52**, respectively, the lobe **42** of the lower portion **40** of the rack bar **34** is received in the central portion **70** of the central cavity **68**. As a result, any tendency of the rack bar **34** to rotate will be resisted by the surfaces defining the central portion **70** of the central cavity **68**.

FIG. **2** shows an enlarged view of the interaction between the first contact surface **50** of the rack bar **34** and the bearing surface **152** of the first roller **144**. Although not discussed, the interaction between the second contact surface **52** of the rack bar **34** and the bearing surface **164** of the second roller **156** will be a mirror image of that described with reference to FIG. **2**.

The rack bar **34** imparts a load on the first roller **144**. The load, represented by F_{RB} in FIG. **2**, is normal to the first contact surface **50** of the lower portion **40** of the rack bar **34**. Thus, the load F_{RB} imparted on the first roller **144** may be divided into a force vector F_A that is parallel to axis A and a force vector F_B that is perpendicular to axis A and directed radially outwardly from axis A toward the first support wall **86** of the yoke **56**.

The force vector F_A is transferred through the first roller **144**, the first bushing **124**, and the first spindle **112** to the main body portion **60** of the yoke **56**. Since the first and second support walls **86** and **88** for the first spindle **112** are located immediately adjacent the first bushing **124** and the first spindle **112** is short relative to the diameter of the main body portion **60** of the yoke **56**, the bending moment applied to the first spindle **112** as a result of force vector F_A is small and will not cause bending of the first spindle **112**. Thus, force vector F_A is completely transferred to the main body portion **60** of the yoke **56**. As a result, the yoke **56** causes the spring **58** to compress and the yoke **56** moves toward the plug **22** an amount necessary for the spring **58** to absorb force vector F_A.

The force vector F_B is transferred through the first roller **144** to the second portion **130** of the first bushing **124**. Force vector F_B forces the first bushing **124** toward the outer side wall **84** of the first blind pocket **80**. By contacting the outer side wall **84** of the first blind pocket **80**, the first bushing **124** acts as a thrust bearing to resist the force vector F_B. As the first bushing **124** rotates relative to the yoke **56** during axial movement of the rack bar **34**, the second portion **130** of the first bushing **124** rubs against the outer side wall **84** of the first blind pocket **80** to resist the force vector F_B. Since the outer side wall **84** of the first blind pocket **80** is coated with a wear resistant, low friction coating, minimal friction and friction related heat is created as a result of the contact between the second portion **130** of the first bushing **124** and the outer side wall **84** of the first blind pocket **80**.

From the above description of the invention, those skilled in the art will perceive improvements, changes and modifications. Such improvements, changes and modifications within the skill of the art are intended to be covered by the appended claims.

Having described the invention, we claim the following:

1. A rack and pinion steering gear comprising:

a housing having an axially extending passage and a yoke bore that extends perpendicular to the axially extending passage and connects with the axially extending passage within the housing, the yoke bore having a yoke bore axis;

a pinion gear rotatably mounted in the housing, the pinion gear having teeth;

a rack bar extending through the axially extending passage of the housing and being movable relative to the pinion gear, the rack bar having teeth in meshing engagement with the teeth of the pinion gear; and

a yoke assembly located in the yoke bore of the housing for at least partially supporting and guiding axial movement of the rack bar relative to the pinion gear,

the yoke assembly comprising a yoke having first and second roller assemblies for contacting the rack bar and rotating during axial movement of the rack bar, a first spindle being fixed against movement relative to the yoke and supporting the first roller assembly, and a second spindle being fixed against movement relative to the yoke and supporting the second roller assembly,

the first roller assembly including a first bushing and a first roller, the first roller being supported by the first bushing and the first bushing being supported by the first spindle about a roller axis, the first bushing transferring a first radial load relative to the roller axis from the first roller to the first spindle,

the second roller assembly including a second bushing and a second roller, the second roller being supported by the second bushing and the second bushing being supported by the second spindle about the roller axis, the second bushing transferring a second radial load relative to the roller axis from the second roller to the second spindle,

the first and second spindles and the first and second bushings, as well as, the first and second rollers being coaxial with one another,

the first spindle, first bushing, and the first roller being axially spaced apart from the second spindle, the second bushing, and the second roller.

2. The rack and pinion steering gear of claim **1** further being defined by:

opposite ends of the first spindle being supported by the yoke, the first roller assembly being supported between the opposite ends of the first spindle; and

opposite ends of the second spindle being supported by the yoke, the second roller assembly being supported between the opposite ends of the second spindle.

3. The rack and pinion steering gear of claim **2** further being defined by:

both the first and second rollers having a bearing surface for contacting the rack bar, the bearing surface of each roller being convex such that point contact is made with the rack bar.

4. The rack and pinion steering gear of claim **3** further being defined by:

both the first and second bushings including a first portion for contacting a respective spindle and a second portion for contacting a portion of an outer surface of a respective roller.

5. The rack and pinion steering gear of claim **4** further being defined by:

the yoke including first and second blind pockets, the first and second blind pockets having an axial width that is greater than an axial width of a respective roller assembly,

the first blind pocket receiving the first roller assembly and the second blind pocket receiving the second roller assembly.

6. The rack and pinion steering gear of claim **5** further being defined by:

each blind pocket including an inner and an outer side wall,

a portion of each bushing contacting the outer side wall of the respective blind pocket.

7. The rack and pinion steering gear of claim **6** further being defined by:

the yoke further including a central channel that is centered between the first and second blind pockets,

the central channel extending axially through the yoke and receiving a portion of the rack bar for preventing rotation of the rack bar relative to the yoke.

8. The rack and pinion steering gear of claim **6** further being defined by:

the inner and outer side walls of each blind pocket being coated with a wear resistant, low friction coating.

9. The rack and pinion steering gear of claim **1** wherein the first and second spindles extend perpendicular to the yoke bore axis and support the first and second roller assemblies, respectively, for rotation in parallel planes.

10. A rack and pinion steering gear comprising:

a housing having an axially extending passage and a yoke bore that extends perpendicular to the axially extending passage and connects with the axially extending passage within the housing;

a pinion gear rotatably mounted in the housing, the pinion gear having teeth;

a rack bar extending through the axially extending passage of the housing and being movable relative to the pinion gear, the rack bar having teeth in meshing engagement with the teeth of the pinion gear; and

a yoke assembly located in the yoke bore of the housing for at least partially supporting and guiding axial movement of the rack bar relative to the pinion gear, the yoke assembly comprising a yoke having first and second roller assemblies for contacting the rack bar and rotating during axial movement of the rack bar, a first spindle being fixed against rotation relative to the yoke and forming a first axis about which the first roller assembly rotates, a second spindle being spaced apart from the first spindle, the second spindle being fixed against rotation relative to the yoke and forming a second axis about which the second roller assembly rotates, the first and second axes being fixed relative to the yoke so that the first and second roller assemblies extend outwardly of the yoke and into contact with the rack bar, the first and second roller assemblies spacing the rack bar apart from the yoke of the yoke assembly.

11. A rack and pinion steering gear comprising:

a housing having an axially extending passage and a yoke bore that extends perpendicular to the axially extending passage and connects with the axially extending passage within the housing;

a pinion gear rotatably mounted in the housing, the pinion gear having teeth;

a rack bar extending through the axially extending passage of the housing and being movable relative to the pinion gear, the rack bar having teeth in meshing engagement with the teeth of the pinion gear; and

a yoke assembly located in the yoke bore of the housing for at least partially supporting and guiding axial movement of the rack bar relative to the pinion gear,

the yoke assembly comprising a yoke having first and second rollers for contacting the rack bar and rotating during axial movement of the rack bar, a first spindle forming a first axis about which the first roller rotates, a second spindle forming a second axis about which the second roller rotates, the first and second spindles being coaxial with one another and being axially spaced apart, the first and second spindles being fixed against rotation relative to the yoke,

a force supplied by the rack bar to the first spindle being transmitted to the yoke through the first spindle and not through the second spindle,

a force supplied by the rack bar to the second spindle being transmitted to the yoke through the second spindle and not through the first spindle.

12. The rack and pinion steering gear of claim **11** further being defined by:

opposite ends of the first spindle being supported by the yoke, the first roller assembly being supported between the opposite ends of the first spindle; and

opposite ends of the second spindle being supported by the yoke, the second roller assembly being supported between the opposite ends of the second spindle.

13. The rack and pinion steering gear of claim **12** further being defined by:

the yoke including first and second blind pockets, the first and second blind pockets having axial widths that are greater than axial widths of the first and second roller assemblies, respectively,

the first blind pocket receiving the first roller assembly and the second blind pocket receiving the second roller assembly.

14. A rack and pinion steering gear comprising:

a housing having an axially extending passage and a yoke bore that extends perpendicular to the axially extending passage and connects with the axially extending passage within the housing;

a pinion gear rotatably mounted in the housing, the pinion gear having teeth;

a rack bar extending through the axially extending passage of the housing and being movable relative to the pinion gear, the rack bar having teeth in meshing engagement with the teeth of the pinion gear; and

a yoke assembly located in the yoke bore of the housing for at least partially supporting and guiding axial movement of the rack bar relative to the pinion gear,

the yoke assembly comprising a yoke having first and second roller assemblies for contacting the rack bar and rotating during axial movement of the rack bar, a first spindle spanning a first gap located between first and second portions of the yoke, the first roller assembly being located in the first gap, the first spindle forming a first axis that is fixed relative to the yoke and about which the first roller assembly rotates, the first spindle transferring forces from the first roller assembly to the first and second portions of the yoke, a second spindle being spaced apart from the first spindle and spanning a second, different gap located between third and forth portions of the yoke, the second roller assembly being located in the second gap, the second spindle forming a second axis that is fixed relative to the yoke and about which the second roller assembly rotates, the second spindle transferring forces from the second roller assembly to the third and fourth portions of the yoke.

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